Marine Ecosystem Management in the San Juan Archipelago

Terrie Klinger
Assoc Professor
School of Marine Affairs
Approach: local, bottom-up planning process for ecosystem-based management science to support decision-making
NWR Wildlife Refuge (83 sites)
National Park (2 sites)
WDFW Urchin Closure
WDFW Research Reserves (5 sites)
SJC Bottomfish Reserves (8 sites)
Whale Watch Operators ‘NO-BOAT’ Zone
Marine Stewardship Area declared
Killer Whale Protection Ordinance adopted
DNR Aquatic Reserve Status requested
San Juan County Marine Stewardship Area planning effort required to prioritize action to develop zoning scheme
The Nature Conservancy’s 5-S planning framework

science-based process for developing and evaluating the effectiveness of conservation strategies

planning performed by volunteer citizens advisory group ‘bottom-up’ approach to ecosystem management
The Nature Conservancy’s 5-S planning framework

1. SYSTEMS: focal conservation targets and their key ecological attributes
2. STRESSES: most serious types of destruction or degradation affecting the conservation targets or key ecological attributes
3. SOURCES of stress: causes or agents of destruction or degradation
4. STRATEGIES: full array of actions necessary to abate the threats of enhance the viability of the conservation targets
5. SUCCESS MEASURES: monitoring process for assessing progress in abating threats
Sources of data used in assessment:

Friday Harbor Labs (100 yrs of biological and ecological studies)
US Department of Energy (intertidal baseline studies 1970s)
National Park Service (intertidal baselines and monitoring)
Washington Dept of Fish and Wildlife (harvested species)
Washington Dept of Natural Resources (habitat studies)
San Juan County (various studies)
NGOs (various studies)
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Rocky intertidal community conservation target identified key ecological attributes e.g., rockweed abundance, age/stage structure

identified and ranked sources of stress to attributes e.g., trampling, harvest, climate change

these based on ‘best professional judgment’ informed by existing science
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  e.g., rockweed abundance, age/stage structure
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informed by existing science

next steps:
identify indicators of viability
determine current status with respect to indicators
<table>
<thead>
<tr>
<th>target</th>
<th>attribute</th>
<th>indicator</th>
<th>poor</th>
<th>fair</th>
<th>good</th>
<th>very good</th>
<th>current status</th>
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<tbody>
<tr>
<td>rocky</td>
<td>abundance</td>
<td>rockweed</td>
<td>&lt;40</td>
<td>40-</td>
<td>70-</td>
<td>90- 100</td>
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<td>70</td>
<td>90</td>
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<td>percent historical</td>
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<td>popn size key species</td>
<td>rockweed abundance</td>
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<td>90-100</td>
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obstacles to assessment due to data deficiencies, unwillingness to guess
Outcome: completed the assessment for most indicators

failed to define indicators or determine current status of some indicators
  prioritization process stopped
  no recommendations made for those indicators

this outcome occurred despite considerable existing scientific data and local expertise
Inability to prioritize conservation action results from mismatch between existing science and management needs.

**Existing Science**
- Process oriented, hypothesis driven
- Experimental studies
  - Short-term
  - Spatially constrained
  - Single factor
- Time series
  - Multiple uncontrolled factors

**Management Needs**
- Decision driven
- Status and trends
- Viability of key species
- Response to specific factors
- Response to interactive factors
- Estimates of uncertainty
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Ecosystem approaches require this information.
### Results of 5-S Evaluation

#### Viability of Focal Targets

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<thead>
<tr>
<th>Marine Biodiversity Targets</th>
<th>Viability</th>
</tr>
</thead>
<tbody>
<tr>
<td>rockfish, lingcod, greenling</td>
<td>fair</td>
</tr>
<tr>
<td>Pacific salmon</td>
<td>fair</td>
</tr>
<tr>
<td>marine mammals</td>
<td>fair</td>
</tr>
<tr>
<td>seabirds</td>
<td>fair</td>
</tr>
<tr>
<td>rocky intertidal</td>
<td>unknown</td>
</tr>
<tr>
<td>rocky subtidal</td>
<td>unknown</td>
</tr>
<tr>
<td>sand, mud, gravel</td>
<td>fair</td>
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## Results of 5-S Evaluation
### Top-Rated Threats to Biodiversity Targets

<table>
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<th>Threat</th>
<th>Rating</th>
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</thead>
<tbody>
<tr>
<td>large oil spills</td>
<td>high</td>
</tr>
<tr>
<td>climate change</td>
<td>high</td>
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<tr>
<td>shoreline modification</td>
<td>high</td>
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<tr>
<td>regional threats to salmon popns.</td>
<td>high</td>
</tr>
<tr>
<td>invasive species</td>
<td>medium</td>
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<td>persistent organic pollutants</td>
<td>medium</td>
</tr>
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<td>stormwater run-off</td>
<td>medium</td>
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<td>septic system discharge</td>
<td>medium</td>
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<td>predation by marine mammals</td>
<td>medium</td>
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<td>historical fishing activities</td>
<td>medium</td>
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...and 6 others
Results of 5-S Evaluation
Research Priorities

Recommended research to determine
- cumulative impacts of overwater structures
- levels of contaminants in seawater
- local sources of contaminants
- maximum allowable concentrations of hydrocarbons, etc
- abundance of forage fish
- status of rocky intertidal and subtidal communities
- current levels of greenhouse gas emissions in SJC
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Marine Stewardship Area Plan generated through 5-S process submitted to review by the public and marine managers
The Nature Conservancy’s 5-S planning framework selected a science-based process for developing and evaluating the effectiveness of conservation strategies.

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Outcome of Review

Top strategies:
Foster a marine STEWARDSHIP ETHIC
Manage UPLAND AND NEARSHORE ACTIVITIES
Reduce HARVEST AND BYCATCH of selected species
Reduce BIOACCUMULATIVE TOXINS
Reduce the RISK OF LARGE OIL SPILLS
Results of 5-S Evaluation
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Biological Invasion of Marine Reserves by Aquatic Nuisance Species

Terrie Klinger and Dianna Padilla

National Sea Grant Aquatic Nuisance Species Program

Students: Paul Bourdeau, Corrina Chase, Erin Cooper, Maris McEdward, Brian Moore, Amber Phillips, Kim Porter, Yuichi Saito
Marine reserves significantly more invaded than reference sites.
Oysters increase

rockweed declines

habitat complexity
algal species diversity
primary production
inputs of DOC, POC
all decline

limpets increase

ecosystem services
Implications: algal biomass, primary productivity, associated ecosystem services appear to decline with increasing oyster density.

Impacts significantly greater in reserves.
Are Marine Reserves Connected through Larval Dispersal?

Janine Kido
Curtis Ebbesmeyer
Irit Altman, Sue Brady,
Megan Ferguson, Rachel Hart,
Daphne Pee, Heidi Theobald,
Brie Van Cleve, Ellen Wilcox

Kim Engie

Sponsors:
Packard Foundation
Dickenson Foundation
Larval Recruitment Study

Drifter accumulation

- Yellow circle: Drifter accumulation
- Red circle: Larval sampling site
Larval abundance by site

No correlation with drifter accumulation
Results of larval recruitment studies: no relationship between coarse measures of oceanography and larval recruitment; difficult to determine linkages

Alternative approach: used oceanographic models to project dispersal envelopes
Mean Distance
Variance
Dispersal after 30 days
Engie and Klinger 2007
self-recruitment
connectivity
export
Engie and Klinger 2007
Trace element signatures of otoliths can be used as natural geochemical tags to infer spatial structure in fish populations.
N=110 fish from 5 regions

Samples of opportunity
**Result:**
spatial structure detectable
despite high degree of variability

**Implication:**
dispersal of juveniles probably limited
movement of adults limited

but: still difficult to determine
linkages between protected areas
### Science Attributes

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San Juan County Marine Resources Committee
The Nature Conservancy
Local Experts
Northwest Straits Commission
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Packard Foundation
Russell Family Foundation
Marine Ecosystem Health Program